Preventing diverticular disease

Review of recent evidence on high-fibre diets

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ABSTRACT

OBJECTIVE To review recent evidence on dietary factors associated with diverticular disease (DD) with special emphasis on dietary fibre.

QUALITY OF EVIDENCE MEDLINE was searched from January 1966 to December 2001 for articles on the relationship between dietary and other lifestyle factors and DD. Most articles either focused on dietary intervention in treating symptomatic DD or were case-control studies with inherent limitations for studying diet-disease associations. Only one large prospective study of male health professionals in the United States assessed diet at baseline and before initial diagnosis of DD.

MAIN MESSAGE A diet high in fibre mainly from fruits and vegetables and low in total fat and red meat decreases risk of DD. Evidence indicates that the insoluble component of fibre is strongly associated with lower risk of DD; this association was particularly strong for cellulose. Caffeine and alcohol do not substantially increase risk of DD, nor does obesity, but higher levels of physical activity seem to reduce risk of DD.

CONCLUSION A diet high in fibre and low in total fat and red meat and a lifestyle with more physical activity might help prevent DD.

RÉSUMÉ

OBJECTIF Faire une revue des données récentes sur le rôle des facteurs alimentaires et plus particulièrement celui des fibres alimentaires dans la maladie diverticulaire (MD).

QUALITÉ DES DONNÉES Les articles portant sur la relation qui existe entre la MD et les facteurs alimentaires et autres habitudes de vie ont été recensés dans Medline entre janvier 1966 et décembre 2001. La plupart des articles traitaient surtout des interventions alimentaires utilisées pour traiter les symptômes de la MD ou rapportaient des études cas-témoin, ce qui limite leur utilité pour l'étude de l'association régime alimentaire-maladie. Une seule étude prospective d'envergure effectuée aux États-Unis chez des professionnels de la santé examinait le régime de base, avant l'établissement d'un diagnostic de MD.

PRINCIPAL MESSAGE Un régime à forte teneur en fibres provenant principalement de fruits et légumes et à faible teneur en graisses totales et en viande rouge diminue le risque de MD. Les données indiquent que la composante insoluble des fibres est fortement associée à un moindre risque de MD; cette relation est particulièrement forte dans le cas de la cellulose. La caféine et l'alcool n'augmentent pas de façon appréciable le risque de MD, ni d'ailleurs l'obésité; par contre, la pratique de l'exercice physique à un niveau élevé semble diminuer ce risque.

CONCLUSION Un régime à forte teneur en fibres et à faible teneur en graisses totales et en viande rouge de même qu'un mode de vie comportant plus d'activité physique pourraient aider à prévenir la MD.

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Diverticular disease (DD) is one of the most common disorders of the colon in the Western world. Although the exact prevalence is not known, the condition is more common among older people. We estimate that DD affects about 10% of those younger than 40 and increases gradually to affect between 50% and 66% of those older than 80.[1-4] Despite an earlier report[5] that DD is more prevalent among women, results of recent studies indicate no such difference in prevalence by sex.[6-8]

In most cases, DD is asymptomatic[9] and is often discovered during routine gastrointestinal investigation. Between 10% and 25% of those affected develop symptoms.[10] Abdominal pain, changes in bowel habits, and bleeding are the most common presenting symptoms.

The terms diverticulosis and DD have generally been used interchangeably to refer to the presence of uninflamed diverticula[11]; however, DD encompasses both asymptomatic diverticulosis and symptomatic diverticulitis. Symptomatic diverticulitis can be complicated (with severe symptoms, such as rupture) or uncomplicated.

Diverticular disease was widely believed to be rare until the beginning of the 1900s, which prompted Painter and Burkitt[2,4] to describe it as a "20th-century problem" and a "disease of Western civilization." The main explanation for the increase in incidence of DD was the decline in dietary fibre intake, particularly cereal fibre intake. Three decades have passed since the fibre hypothesis was widely publicized, and several studies have investigated the association between fibre, fibre sources, other dietary components, and lifestyle factors in the increasing incidence of DD (**Table 1**).

Bowel health is negatively influenced by high colonic intraluminal pressure. Stress on the wall of the colon varies according to intraluminal pressure (pressure = [thickness • stress]/radius). High-fibre foods increase the diameter of the colon and hence lower intraluminal pressure. When intraluminal pressure is high, stress over time can lead to degenerative changes that result in development of diverticula (level III evidence).[12]

Many believe that regular physical activity improves bowel health. A consistent finding in studies with level II evidence[13,14] has been that bowel function is enhanced due to increased gastrointestinal transit time.

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Table 1. Potential risk factors for diverticular disease

DIETARY
Low intake of fibre
High intake of red meat
High intake of total fat
Caffeine consumption
Alcohol consumption
NONDIETARY
Little physical activity
High body mass index
Smoking

This article reviews recent evidence on the role of diet and other lifestyle factors in the etiology of DD and how dietary intervention, in particular, can help reduce risk of DD.

Quality of evidence

MEDLINE was searched from January 1966 to December 2001 for articles on the relationship between dietary and other lifestyle factors and DD, using the key words diverticular disease, diverticulosis, diet, fibre, physical activity, and meat. Most reports were clinical trials on the role of dietary intervention in treating symptomatic DD or were case-control studies (level II evidence) with their inherent limitations for studying diet-disease associations. Only a single large (51 529 subjects) prospective study, the Health Professionals Follow-Up Study,[15] of male health professionals aged 40 to 75 years old in the United States assessed diet at baseline and before initial diagnosis of DD. In case-control studies, reporting dietary intake data after onset of disease carries a high risk of bias.

Dietary fibre

Recent information suggests that the early theory of Painter and Burkitt[2] (that DD arises from a deficiency of dietary cereal fibre) needs to be revised to include vegetable and fruit fibre. Cellulose could be a key component in the diet–DD relationship, and both vegetable and fruit fibre is higher in cellulose than cereal fibre.[16,17] **Table 2**[17] shows the percentage of cellulose in vegetable, fruit, and cereal fibre.

Types of fibre vary considerably in their physical properties and chemical composition. Crude fibre consists of cellulose and lignin. Lignin is a noncarbohydrate polymer that forms part of the structure of the cell walls of woody tissues. Human

Table 2. Total fibre* content of human diets

FOOD TYPE	CRUDE FIBRE CELLULOSE (%)	LIGNIN (%)	NON-CELLULOSE POLYSACCHARIDES (%)
Fruit	20	17	63
Vegetables	31	3	66
Cereal†	17	7	75

Data from Slavin.[17]
**Crude fibre consists of cellulose and lignin. Dietary fibre consists of crude fibre and non-cellulose polysaccharides.*
†Numbers do not add to 100 because of rounding to nearest whole number.

food contains only small amounts of lignin.[17] Dietary fibre includes crude fibre and non-cellulose polysaccharides, hemicelluloses, pectins, and gums.[18] In the past, researchers were able to measure only cellulose and lignin, but newer methods of measurement are now available that can determine the dietary content of other fibre components that play an important role in human health.

Dietary fibre can also be classified according to its water solubility. The structural fibres [cellulose, lignin, and some hemicelluloses] are insoluble; the natural gel-forming fibres [pectins, gums, mucilages, and remaining hemicelluloses] are soluble.[19] Insoluble fibre, such as wheat bran, is primarily important for bowel health, while soluble fibre, such as oat bran, has been thought to reduce risk of chronic disease. **Table 3**[19] shows foods that contribute to total dietary fibre by fibre type and serving size.

In the Health Professionals Follow-Up Study, intake of fruit and vegetable fibre was inversely associated with risk of DD.[19] For highest versus lowest quintile, relative risk (RR) associated with fruit fibre was 0.62 (95% confidence interval [CI] 0.45 to 0.86); RR associated with vegetable fibre was 0.55 (95% CI 0.37 to 0.84). The insoluble component of fibre, particularly cellulose, was strongly associated with decreased risk of DD (RR 0.55, 95% CI 0.39 to 0.78). Cereal fibre, however, was not associated with decreased risk of DD.

A study from Greece (level II evidence) compared people who frequently consumed vegetables but rarely ate meat with people who frequently consumed meat but rarely ate vegetables.[20] Risk of developing DD was almost 50-fold higher for meat eaters. A study comparing vegetarians (mean dietary fibre intake 41.5 g/d) to nonvegetarians (mean dietary fibre intake 21.4 g/d) found that the incidence of DD was 33% among nonvegetarians, but only 12% among vegetarians.[21]

Fat

Fat intake appears to be related to DD, particularly when dietary fibre intake is low. Positive associations were found between DD and saturated, monounsaturated, transsaturated, and polyunsaturated fats. A weak inverse association was observed for ω-3 fatty acids and DD. When adjusted for physical activity and dietary fibre, however, the association of DD with total fat and various types of fat was no longer significant (level II evidence).[22]

Red meat

The Health Professionals Follow-Up Study was the first prospective study to examine the relationship

Table 3. Contributions to total dietary fibre: *Fibre types and serving sizes.*

FOODS	CONTRIBUTION TO TOTAL DIETARY FIBRE* (%)	SERVING SIZE (G)	TOTAL DIETARY FIBRE (G)	SOLUBLE FIBRE (G)	INSOLUBLE FIBRE (G)	HEMICELLULOSE (G)	CELLULOSE (G)	LIGNIN (G)
Cold cereal†	8.81	1 cup (47)	6.00	1.04	4.40	3.29	0.68	0.24
Potatoes	6.36	1 cup (210)	4.20	1.59	1.98	0.27	1.60	0.11
Apple	6.33	1 (138)	3.70	0.83	1.69	0.64	1.03	0.02
Banana	4.11	1 (114)	2.70	0.34	1.22	0.26	0.50	0.67
Dark bread	3.90	1 slice (25)	1.10	0.28	2.10	1.58	0.33	0.20
Orange	3.78	1 (131)	3.10	1.96	0.64	0.03	0.31	0.31
Peas	3.28	1/2 cup (80)	4.40	0.48	2.89	0.66	2.14	0.22
Carrots	2.82	1/2 cup (78)	2.60	1.09	1.40	0.15	0.97	0.11
Tomato sauce	2.74	1/2 cup (125)	4.20	0.63	3.15	0.45	1.97	0.69
Beans	2.69	1/2 cup (131)	6.70	2.24	11.11	8.05	2.79	0.23

Adapted from Aldoori et al.[19]

**By comparison, 1 tablespoon of psyllium hydrophilic mucilloid (eg, Metamucil®) daily provides 10.2 g of dietary fibre.*
†Includes bran cereals; Shredded Wheat® was most commonly reported.

between red meat consumption and DD. Age and energy-adjusted RRs were significant for certain servings of meat, such as beef, pork, and lamb as a main dish (RR 3.23, 95% CI 1.47 to 7.08, *P* for trend .01); in sandwiches or mixed dishes (RR 1.98, 95% CI 0.75 to 5.21, *P* for trend .002); processed meat (RR 1.90, 95% CI 1.20 to 3.00, *P* for trend .0008); bacon (RR 1.07, 95% CI 0.52 to 2.19, *P* for trend .009); and hot dogs (RR 1.38, 95% CI 0.84 to 2.25, *P* for trend .001).

When further adjusted for dietary fibre intake and physical activity, consumption of red meat, as a single category, was still positively associated with risk of DD (RR 1.48, 95% CI 1.00 to 2.19). The association, however, was non-linear; thus, the trend did not reach statistical significance (*P* for trend .24). Further analysis showed that the association of red meat with DD was not related to its protein or fat content. There was little association between DD and intake of chicken and fish (RR 1.12, 95% CI 0.79 to 1.57, *P* for trend .95) or dairy fat (RR 0.94, 95% CI 0.67 to 1.34, *P* for trend .43) (level II evidence).[22]

High-meat diets are known to change bacterial metabolism in the colon (level II evidence).[23] It is possible that the interaction of red meat and bacteria results in production of a "toxic metabolite," perhaps a spasmogen, that weakens the colon wall and creates a favourable condition for formation of diverticula.[24] Red meat might also exert an unknown physiologic action or be a proxy for other factors that influence development of DD. In Asians, meat consumption has been associated with right-sided diverticulosis (odds ratio [OR] 24.81 between most and least frequent meat eaters, *P* for trend <.01), indicating interactions between dietary habits and ethnicity (level II evidence).[25]

The influence of red meat on DD and whether there is biologic interaction between dietary fibre and red meat need to be explored. One study showed that patients with DD had higher average daily fecal bile acid output than controls. The acid output was reduced to nearly the level of controls' output after administration of bran (level II evidence).[26] These findings led some to suggest that DD is a motility disorder that can be reversed by higher intake of dietary fibre (level III evidence).[27]

Table 4[19] shows some of the foods examined in the Health Professionals Follow-up Study and indicates whether they increase or decrease risk of DD. The pattern indicated in the table reinforces the importance of current nutrition recommendations to increase consumption of fruit.

Table 4. Foods associated with symptomatic diverticular disease

FOOD	INCREASED RISK	DECREASED RISK
Beef, pork, or lamb as a main dish	✓	
Processed meat, 1 piece or slice	✓	
Beef, pork, or lamb in a sandwich or mixed dish	✓	
Bacon, 2 slices	✓	
Hot dog, 1	✓	
Romaine or leafy lettuce, 1 serving		✓
Peaches, apricots, or plums, 1 fresh or 100 g canned		✓
Oranges, 1		✓
Apples, 1		✓
Blueberries, 100 g		✓
Cookies, ready-made, 1	✓	
Potato or corn chips, 1 small bag	✓	
French fried potatoes	✓	
White bread, 1 slice	✓	

Adapted from Aldoori et al.[19]

Alcohol and caffeine

Alcohol and caffeine have been identified as risk factors for several digestive diseases. Whether these substances could help explain the differences in incidence of DD in developed and developing countries was investigated in the Health Professionals Follow-Up Study.

After adjusting for age, physical activity, and energy-adjusted intake of dietary fibre and total fat, alcohol intake (comparing those who drink >30 g of alcohol a day with abstainers) was only weakly and non-significantly associated with risk of symptomatic DD (RR 1.36, 95% CI 0.94 to 1.97, *P* for trend .37). No association was observed between caffeine, certain caffeinated beverages, and decaffeinated coffee and risk of symptomatic DD (level II evidence).[28]

Other lifestyle factors

The effect of other lifestyle factors, such as physical activity and smoking, has also been considered for risk of DD. Two case-control studies (level II evidence)[20,29] addressed the potential relationship between smoking and DD, but found no association. Current smokers were not appreciably at risk of symptomatic DD compared with non-smokers. Risk among past smokers was not higher among men who stopped smoking 3 or more years before diagnosis of DD.[28]

Physical activity affects colonic function, particularly by reducing intestinal transit time. In the Health Professionals Follow-up Study, overall physical activity was inversely associated with risk of symptomatic DD, but most of this association was attributable to vigorous activity (level II evidence).[30] Jogging and running combined were the only activities that were statistically significant for trend (highest to lowest comparison, RR 0.52, 95% CI 0.27 to 1.0, *P* for trend .03). Men with the lowest levels of total physical activity and dietary fibre intake were at much higher risk of symptomatic DD (RR 2.56, 95% CI 1.36 to 4.82). Although a high-fibre diet is likely the most important factor in preventing symptomatic DD, the benefits of physical activity for overall health are clear.

Conclusion

Diet and lifestyle factors are often implicated in digestive disease, and evidence indicates that this is true for DD. Patients presenting with gastrointestinal complaints should be assessed for specific dietary practices and overall physical activity.

Intake of fibre should be assessed, and patients counseled to eat more fruits and vegetables because of their higher cellulose content. Red meat eaters can be encouraged to substitute chicken, fish, or meat alternatives, such as legumes, that are notably high in fibre, at least at some meals. Patients who take bran supplements will benefit more from coarse bran supplements.

In conducting general lifestyle assessments, physicians can encourage patients to increase physical activity. While vigorous activity, in particular, seems to be beneficial for reducing risk of DD, any increase in physical activity can improve bowel function.

Editor's key points

- Many studies have explored the dietary and lifestyle factors that influence diverticular disease (DD), but most are case-control studies (level II evidence). Only one prospective trial (level I evidence) has been published.
- Strong evidence indicates that dietary fibre, especially the insoluble fibre found mostly in fruits and vegetables rather than cereals, decreases risk of DD.
- Some evidence shows that consuming red meat increases risk of DD.
- Alcohol, caffeine, and smoking do not appear to influence DD; vigorous exercise seems to reduce DD.

Points de repère du rédacteur

- L'influence des facteurs alimentaires et des habitudes de vie sur la maladie diverticulaire (MD) a fait l 'objet de plusieurs études, mais la plupart de ces études étaient du type cas-témoin (preuves de niveau II). Une seule étude prospective (preuves de niveau I) a été publiée.
- Les données suggèrent fortement que les fibres alimentaires, notamment les fibres insolubles qu'on trouve surtout dans les fruits et légumes plutôt que dans les céréales, réduisent le risque de MD.
- Certaines données indiquent aussi que la consommation de viande rouge augmente le risque de MD.
- L'alcool, la caféine et le tabac ne semblent pas avoir d'influence; un niveau élevé d'exercice physique semble réduire le risque de MD.

Competing interests

None declared

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